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The Influence of the Rate of Fat Deposition on the Firmness of the Fat of Hogs

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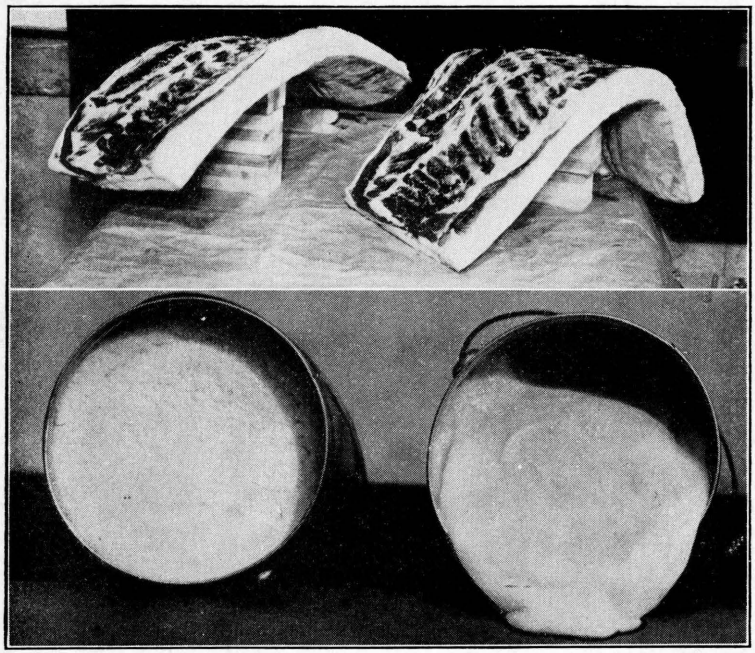

Firm pork products (left) are more attractive than soft products (right)

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THE INFLUENCE OF THE RATE OF FAT DEPOSITION ON THE FIRMNESS OF THE FAT OF HOGS

W. L. ROBISON

Soft or oily pork products are disliked by consumers. Lard from soft hogs is a semi-liquid product which does not properly harden at ordinary temperatures, and the sausage will not hold its shape. Because of the softness of the fat contained, loins from soft hogs become smeary and unattractive in appearance when they are placed on the counter or in the showcase. The bacon is soft and flabby, presents a displeasing appearance, and is difficult to slice, even with a machine. The hams are affected to a less extent but even these are not as attractive as are those from firm hogs. Such characteristics, coupled with a greater loss from shrinkage, cause discrimination against soft pork products.

The firmness of pork from well finished hogs depends largely on the firmness of the fat it contains (9). The firmness of fat under a given set of conditions depends on its composition. Feed is the chief factor in influencing the composition of the fat of an animal (8). The fat, or ether extract, of most of the feeds commonly fed to hogs is soft; that is, an oil or liquid at ordinary temperatures (9). Feed-fat is not changed materially in firmness in its conversion into animal fat (6). Not all animal fat is derived from feed-fat. Some is synthesized from carbohydrates. Proteins can also be utilized by animals for the production of body fat. Animal fat that is synthesized from carbohydrates or protein is normally firm (6).

Cooperative soft pork investigations which were carried on by the U. S. Department of Agriculture and a number of state experiment stations showed that rations low in fat produced firm pork whereas those high in soft fats produced soft pork, regardless of the weight at which the hogs were slaughtered (7 and 9). When corn and other feeds containing medium amounts of fat were fed there was a direct relationship between maturity and the firmness of the pork. Medium type pigs fed corn or corn and wheat middlings with skimmed milk, tankage, or fish meal, in dry lot or on pasture, usually killed out soft when they were slaughtered at weights of less than 175 pounds, and firm when slaughtered at heavier weights.

Young pigs ordinarily store relatively small amounts of fat. During this stage of development, when the growth impulse is strong, the amount of fat deposited or stored by the animal may be little more than the amount of oil contained in the feed consumed. As full-fed pigs become heavier and approach normal market weights, they lay on fat at a much more rapid rate. At this stage, unless the ration is unusually high in fat, a much smaller proportion of the fat stored by the animal is derived from the fat in the feed. A larger percentage must be synthesized from the carbohydrate or protein portion of the feed. Presumably, the change to a firmer fat as pigs on medium-fat rations become heavier is due to the increasingly larger percentage of the fat being derived from the carbohydrates and protein in the ration (9). If this assumption is correct, enteric troubles or other diseases, parasitic infestations, insufficient feed, or other factors which would retard the rate of fat deposition would cause the fat to be less firm than that of faster-gaining hogs slaughtered at the same weight.

The experiments reported here were conducted to study the question of whether the rate at which the fat is deposited influences the firmness of the fat in hogs.

EXPERIMENT 1

Plan of Experiment

In the first trial, rations containing 2.6, 5.6, and 8.7 per cent, or low, medium, and high levels of fat, were each fed to two groups of pigs. One group was self-fed for rapid gains. The daily feed for the other group was limited to approximately 2.75 per cent of their weight so that they would gain more slowly. The various feeds in the rations were kept at constant ratios throughout the experiment—that is the protein content of the rations was not decreased at any time during the trial. The grain consisted of two parts of wheat to one of corn, by weight. Dried skimmed milk, soybean oil meal, cottonseed meal, and ground alfalfa made up 2, 4, 3, and 4 per cent of the total feed, respectively. One per cent of minerals was included in the low-fat ration and 0.8 per cent in the other two. The low-, medium-, and high-fat rations contained 5, 5.7, and 6.2 per cent of fish meal, respectively. Three and one-tenth per cent of corn oil, which was used to alter the fat content, was included in the medium- and 6.2 per cent in the high-fat ration. Table 1 shows the composition of the feeds used. Table 2 lists the three rations, along with the respective protein, ash, and fat content.

TABLE 1.—Analyses of feeds used

	Dry matter	Moisture	Protein	Ether extract	Fiber	Nitrogen-free extract	Ash
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Yellow corn	85.40	14.60	8.31	4.01	2.17	69.65	1.26
Wheat	87.56	12.44	11.94	1.73	2.36	69.77	1.76
Menhaden fish meal	92.77	7.23	62.06	5.49	2.91	4.99	17.32
Toasted extracted soybean oil meal	88.82	11.18	47.44	.61	5.90	29.71	5.16
Expeller cotton-seed meal	91.73	8.27	42.25	6.11	10.22	26.92	6.23
Dried skimmed milk	92.77	7.23	34.88	.39	.44	49.37	7.69
Ground alfalfa	91.31	8.69	17.00	1.84	26.36	39.07	7.04

At the start, each group contained 24 pigs which averaged approximately 52 pounds in weight. Four other pigs representative of those used in the experiment were slaughterd at the beginning of the test. Two, two, and ten pigs from each group were slaughtered when their individual weights approximated 100, 150, and 200 pounds, respectively. As each remaining pig reached a weight of approximately 250 pounds it was removed and slaughtered.

At weights of approximately 100, 150, and 200 pounds, back fat samples were taken from five pigs in each of the six lots. From the time the first fat samples were taken at the 100-pound weight (which was on the fifty-sixth day in the case of the full-fed pigs of lots 1, 3, and 5; and on the seventieth day in the case of the limited-fed pigs of lots 2, 4, and 6) these five pigs were kept separate from the remainder of the group. They were designated as section B and the others as section A of their respective lots.

At the 200-pound weight, back fat samples were taken from all of the pigs that were carried to the 250-pound weight—that is those in section A as well as those in section B. This permitted determining the refractive index of the back fat of the 19 or 20 head remaining in each group at the 200-pound weight, although some of them were not slaughtered until they reached a weight of 250 pounds. The refractive index was used as a measure of the firmness of the fat.

Feed Lot Performance

Table 3 summarizes the feed lot performance of the different groups of pigs in experiment 1. A pig which failed to gain from the start was removed from each of lots 4 and 6 on the fifty-sixth day. One in lot 1 died on the twenty-eighth day. No deduction was made for the feed consumed by these while they were in their respective lots. The data include those for the pigs slaughtered at the 100- and 150-pound weights and also those for the pigs from which the fat samples were taken at the 100-, the 150-, and the 200-pound weights.

From the beginning of the test to an average weight of approximately 200 pounds the pigs of lots 1, 3, and 5, except those from which fat samples were removed, made average daily gains of 1.40, 1.32, and 1.33 pounds, respectively. Animals in lots 2, 4, and 6 carried to 200 pounds, from which fat samples were not removed, made average daily gains of 0.79, 0.90, and 1.00 pounds, respectively.

In the limited-fed groups, each increase in the fat content of the ration resulted in an increase in the rapidity of the gains and in a lowering of the feed required per unit of gain. Fats are known to furnish approximately 2.25 times as much heat or energy per pound from oxidation as do carbohydrates. Multiplying the fat by 2.25, to place it on a carbohydrate equivalent, showed that the differences in the energy value of the rations due to the larger amounts of fat were sufficient to account for only a portion of the saving in feed per unit of gain.

For some reason, the pigs of lot 3, self-fed the ration containing a medium amount of fat, failed to perform normally at the beginning of the test. During the first 8 weeks, the pigs of lots 1, 3, and 5 gained 1.05, 0.85, and 0.98 pounds daily a head, consumed 3.32, 2.98, and 3.05 pounds of feed daily a head, and required 317, 351, and 310 pounds of feed per 100 pounds of gain, respectively. During this period, the feed requirements per 100 pounds of gain, when the fat was multiplied by 2.25, were 328, 375, and 344 pounds for the three groups as named.

For the remainder of the test, or after the first 8 weeks, the pigs in lots 1, 3, and 5 gained 1.61, 1.70, and 1.64 pounds daily a head; consumed 6.75, 6.59, and 5.86 pounds of feed daily per head; and required 419, 387, and 357 pounds of feed per 100 pounds of gain, respectively. With the fat multiplied by 2.25, the quantities of feed required per 100 pounds of gain during this period were 432, 414, and 396 pounds, respectively.

Thus, except for the first few weeks, like the limited-fed pigs, the full-fed pigs given rations containing the higher levels of fat made greater gains per unit of feed consumed and also greater gains per unit of energy received than did those given rations containing less fat.

TABLE 2.—Plan of feeding

Lot	Kinds of feed	Amounts	Protein	Ash	Fat
		Pct.	*Pct.*	*Pct.*	*Pct.*
1 and 2	Grain	81.0			
	Protein concentrate	14.0			
	Ground alfalfa	4.0	16.3	3.8	2.6
	Minerals	1.0			
3 and 4	Grain	77.4			
	Protein concentrate	14.7			
	Ground alfalfa	4.0	16.4	3.8	5.6
	Minerals	.8			
	Corn oil	3.1			
5 and 6	Grain	73.8			
	Protein concentrate	15.2			
	Ground alfalfa	4.0	16.3	3.9	8.7
	Minerals	.8			
	Corn oil	6.2			

Lots 1, 3, and 5 were self-fed for rapid gains, whereas lots 2, 4, and 6 were limited-fed for slower gains. The daily allowance of feed for the limited-fed pigs approximated 2.75 per cent of their weight.

The grain consisted of one part of corn to two parts of wheat, by weight. These were ground and mixed with the other feeds. Each ration contained 4 per cent of toasted, extracted soybean oil meal, 3 per cent of expeller cottonseed meal, and 2 per cent of dried skimmed milk. Menhaden fish meal made up the remainder of the protein concentrate, or 5.0, 5.7, and 6.2 per cent, respectively, of the low, medium, and high fat rations. No changes in the percentages were made throughout the experiment.

The minerals consisted of salt, 19.2 per cent; pulverized limestone, 38.4 per cent; special steamed bonemeal, 38.4 per cent; and ferrous sulfate, 4 per cent, by weight.

TABLE 3.—Feed lot performance of pigs in experiment 1

Lot number	1	2	3	4	5	6
Per cent of fat in ration	**2.6**		**5.6**		**8.7**	
Amount of feed	Full	Limited	Full	Limited	Full	Limited
Pigs at start	24	24	23	23	24	23
Initial weight per pig, lb.	52.8	51.7	53.1	52.2	53.0	52.0
Final weight per pig, lb.	206.7	206.3	211.9	209.1	202.6	211.1
Average daily gain, lb.	**1.34**	**.85**	**1.30**	**.94**	**1.32**	**1.03**
Daily feed per pig, lb.:						
Grain	4.15	2.70	3.77	2.65	3.30	2.49
Protein concentrate	.72	.47	.72	.50	.68	.51
Ground alfalfa	.21	.13	.19	.14	.18	.13
Minerals	.05	.03	.04	.03	.03	.03
Corn oil			.15	.11	.28	.21
Total	5.13	3.33	4.87	3.43	4.47	3.37
Feed per 100 lb. gain, lb.:						
Grain	309.08	317.58	290.88	282.63	250.68	241.46
Protein concentrate	53.42	54.89	55.24	53.67	51.62	49.73
Ground alfalfa	15.26	15.68	15.03	14.61	13.59	13.09
Minerals	3.82	3.92	3.01	2.92	2.72	2.62
Corn oil			11.65	11.32	21.06	20.28
Total	**381.58**	**392.07**	**375.81**	**365.15**	**339.67**	**327.18**
Feed per 100 lb. gain with fat x 2.25	393.89	404.71	402.26	390.85	376.48	362.64

Lowered daily feed intakes in the case of the self-fed pigs indicated that increased amounts of fat reduced the palatability of the ration or else resulted in a need for less feed to satisfy the appetite.

Removal of Fat Samples

The fat samples were taken from the live pigs by Dr. D. W. Ashcraft, of the Veterinary College, Ohio State University, and Dr. Forest Ewing, a local practicing veterinarian. The pigs were anesthetized. The hair was clipped from an area over the loin. The area was sterilized. An incision at an angle of approximately 10 to 20 degrees from the vertical position was made. A sample of fat the thickness of the fat layer or down to the muscular tissue was removed and the wound was then loosely ligatured. No infections occurred.

Choral hydrate, administered anally, was first used as the anesthetic. It acted rather slowly and did not always fully anesthetize the animal. Nembutol was then tried, both intra-peritoneally and intra-venously. It was more satisfactory for the purpose and was used thereafter. Injecting it intravenously proved to be the preferable method of administration in that the response was practically instantaneous. The amount required for anesthesia varied but when the nembutol was given intra-venously the proper dosage could be fairly accurately gauged by watching the response of the animal. The nembutol was injected through a vein in the ear.

Some conception of the effect of taking the fat samples from the live pigs on their subsequent performance can be gained from the data presented in table 4, which shows the feed required per 100 pounds of gain by sections A and B of each lot while the pigs were between 100 and 200 pounds in weight, and the comparative rates of gains of the pigs in the two sections before and after they were separated.

Apparently the performance of the limited-fed pigs was at too low a level to be adversely affected by the operations. The rapidity of their gains in relation to that of the other section of their respective lots was higher after than before they were operated on. In the 100- to 200-pound weight period they required less rather than more feed per unit of gain than those of the other section of their respective lots. Since they were fed together in the earlier period, the relative amounts of feed required per unit of gain at that time is not known.

The rapidity of the gains of the full- or self-fed pigs was retarded by the removal of the fat samples. The pigs of section B of lot 3 gained 6 per cent faster than those of section A before, and 13 per cent slower after the fat samples were removed. Those of section B of lot 5 gained 9 per cent slower than those of section A before, and 21 per cent slower after the fat samples were removed. The pigs of section B of lot 1 gained 15 per cent slower than those of section A before and 13 per cent slower after the fat samples were removed. During the 100- to 200-pound weight period, in each instance, the pigs of section B of lots 1, 3, and 5 required more feed per unit of gain than those of section A.

Shrinkage in Transit, Killing, Cooling, and Cutting

When removed for slaughter, the pigs were taken from the feed lot and weighed individually early in the morning just prior to trucking to the packing plant at Canton—a distance of 32 miles. No small scales were available at the packing plant. Since the break of the large scales was too great for

TABLE 4.—Effect of removing fat samples on the performance of pigs

Lot	1		2		3		4		5		6	
Section	A	B	A	B	A	B	A	B	A	B	A	B
Number of pigs	14	5	15	4	14	5	14	5	15	3	14	5
Initial weight per pig, lb	54	49	51	55	56	46	52	51	54	56	51	51
Weight per pig when separated, lb	117	103	88	96	107	99	104	93	109	106	99	96
Average daily gain to time of separation, lb	1.13	.96	.54	.60	.89	.94	.73	.61	.99	.90	.67	.63
Rate of gain **before**, compared with that of pigs not operated on, per cent	.....	85	.....	111	.....	106	.....	84	.....	91	.....	94
Final weight per pig, lb	201	206	173	203	200	205	193	195	199	198	207	211
Average daily gain, 100 to 200 pound weight, lb	1.68	1.46	.93	1.09	1.74	1.51	.99	1.03	1.65	1.31	1.25	1.27
Rate of gain **after**: compared with that of pigs not operated on, per cent	.....	87	.....	117	.....	87	.....	104	.....	79	.....	102
Feed per 100 pounds of gain from 100 to 200 pounds in weight	403	414	402	371	360	392	400	373	348	356	326	313

accurate individual weights the pigs were weighed in groups as they were slaughtered, regardless of the lots from which they came. The individual live weights on arrival at the packing plant were calculated from the total selling weight on a basis of the percentage their individual weights were when compared to the total weight previous to trucking. Thus, the shrinkage in transit figures are reliable for the total number but may not be reliable indexes of differences due to weight, quantity of feed received, or amount of fat in the ration.

The warm and cold dressed weights and the weights of the various cuts were obtained on each pig in the experiment. The securing of the slaughter data, which was no small task, was made possible through the courtesy and cooperation of the Canton Provision Company. The warm and cold dressed weights were taken with the heads and ham facings on and the leaf fat and kidneys in. Usually the cooled dressed weights were taken the second day after slaughter. In a few instances, they were not taken until the third day.

Based both on the individual live weights before trucking and on the calculated individual live weights at the packing plant just before slaughter, the yields of the warm and cooled carcasses and of the cuts of the full- and of the limited-fed pigs of the different weights are given in table 5.

In the cutting process, the layer of fat was skinned from the butt end of the ham. The portion removed was weighed with the fat trimmings. The cheeks or jowls were weighed separately but what lean and fat could be removed were trimmed from the head and weighed with the fat and lean trimmings.

The average thickness of the back fat was determined from measurements taken at five points. These were (1) the seventh dorsal vertebra, (2) the first dorsal vertebra, (3) the seventh vertebra below the last lumbar with the last lumbar vertebra included in the count, (4) the point 3½ vertebra below the last lumbar, with the last lumbar included in the count, and (5) the last lumbar vertebra. A back fat sample the full depth of the fat layer was taken from each carcass. Portions of the sample, removed with a cork cutter, were rendered in a three-eighths inch test tube in a constant temperature electric oven at 115° C. for 8 hours. The refractive index of the lard or rendered fat at a temperature of 40° C. was determined with an Abbe refractometer.

Yields of Pork Cuts

Tables 6, 7, 8, and 9 summarize the cutting data. The total cutting yields of the carcasses are based on the live weights before trucking and include the head remains as shown in the tables.

As the pigs became heavier and fatter the cutting yields increased.

Although there were some exceptions, usually the full-fed pigs were fatter and showed a higher yield of cuts or a higher average dressing percentage than the limited-fed pigs of similar weight.

The yields of the various cuts are expressed in percentages of the total carcass weights. The carcasses of the limited-fed pigs contained a higher percentage of loin and of trimmed ham and a lower percentage of fat cuts than the carcasses of the full-fed pigs of similar weight. Limiting the feed somewhat has the disadvantage of lengthening the feeding period and thus increasing the labor, risks, and overhead costs involved but the advantage of resulting in more pork per unit of feed consumed and, when lard is relatively low in price, of producing a carcass of higher value.

TABLE 5.—Shrinkages from transporting, killing, cooling, and cutting; experiment 1

	Full-fed pigs Lots 1, 3, and 5					Limited-fed pigs Lots 2, 4, and 6			
Approximate weight at slaughter, lb.	**50**	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	4	6	6	30	26	6	6	30	27
Average weight at Wooster, a. m., lb.	55.4	105.6	152.3	204.6	253.7	104.7	152.2	206.7	255.8
Average weight at Canton, a. m., lb.	56.2	103.8	150.3	200.4	248.7	103.3	149.0	203.2	252.2
Shrink in transit, per cent	+1.6	1.7	1.3	2.1	2.0	1.3	2.1	1.7	1.4
Average warm, dressed weight, a. m., lb.	37.2	75.9	114.0	157.8	202.0	76.5	112.7	158.8	204.5
Warm dressed yield, per cent									
Basis Wooster weight	67.3	71.9	74.8	77.1	79.6	73.1	74.0	76.8	80.0
Basis Canton weight	66.2	73.2	75.9	78.8	81.2	74.1	75.6	78.2	81.1
Average cooled, dressed weight, lb.	35.6	73.8	110.3	153.7	197.6	74.7	109.5	154.8	198.7
Shrink in cooling, per cent	4.4	2.9	3.2	2.6	2.2	2.3	2.8	2.5	2.8
Cooled, dressed yield, per cent									
Basis Wooster weight	64.3	69.9	72.4	75.1	77.9	71.4	72.0	74.9	77.7
Basis Canton weight	63.3	71.1	73.4	76.7	79.5	72.4	73.5	76.2	78.8
Average weight of cuts and trimmings, lb.	38.3	75.4	112.5	155.2	198.5	77.6	112.8	155.7	199.2
Yield of cuts and trimmings, per cent									
Basis Wooster weight	**69.2**	**71.4**	**73.8**	**75.8**	**78.2**	**74.2**	**74.1**	**75.4**	**77.9**
Basis Canton weight	68.1	72.6	74.9	77.4	79.8	75.1	75.7	76.6	79.0

TABLE 6.—Slaughter data of pigs in experiment 1; representative pigs at start, and lots 1 and 2

Lot	Representative pigs	Low fat rations							
		Lot 1—Rapid gaining				Lot 2—Slower gaining			
Approximate weight at slaughter, lb.	**50**	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	4	2	2	9	10	2	2	10	9
Average daily gain, lb.	0.60*	0.90	1.15	1.42	1.36	0.73	0.73	0.80	0.94
Average weight at Wooster, lb.	55.4	108.5	154.0	204.1	253.5	101.7	151.5	209.0	256.5
Average weight at Canton, lb.	56.2	105.5	152.2	200.5	248.0	100.5	148.5	205.9	253.2
Shrink in transit, per cent	+1.6	2.8	1.1	1.8	2.2	1.2	2.0	1.5	1.3
Average weight of cuts, lb.	38.3	76.5	116.2	155.2	199.2	75.6	109.9	157.5	199.4
Cutting yield, per cent of Canton weight	69.2	70.5	75.4	76.0	78.6	74.3	72.5	75.4	77.7
Lean cuts, per cent of carcass									
Hams, skinned	17.81	17.09	19.04	15.57	15.07	18.55	18.89	17.18	16.37
Loins	13.80	13.96	13.83	11.96	12.09	15.62	15.66	13.45	12.60
Shoulders	16.32	14.92	15.09	13.38	13.19	15.12	16.93	14.61	14.05
Lean trimmings	2.41	4.29	7.26	7.08	6.75	7.31	4.95	7.10	6.07
Total	**50.34**	**50.26**	**55.22**	**47.99**	**47.10**	**56.60**	**56.43**	**52.34**	**49.09**
Fat cuts, per cent of carcass									
Sides	12.68	9.61	9.91	11.27	10.61	9.05	10.04	9.92	10.90
Cheeks	3.00	2.35	2.64	2.30	2.24	2.11	2.22	2.41	2.67
Skinned back fat	3.42	5.35	5.27	7.90	8.82	3.57	3.57	6.17	7.15
Fat trimmings	5.05	8.77	8.63	13.28	13.74	8.14	6.66	10.83	12.27
Leaf fat	.92	1.25	1.24	2.68	2.81	1.20	1.31	2.21	2.59
Total	**25.07**	**27.33**	**27.69**	**37.43**	**38.22**	**24.07**	**23.80**	**31.54**	**35.58**
Bony cuts, per cent of carcass									
Spareribs	3.58	3.82	2.88	2.47	2.17	3.18	3.24	2.58	2.48
Neck bones	2.59	2.15	1.61	1.40	1.66	1.88	2.08	1.68	1.56
Feet	4.83	4.21	3.71	2.91	2.82	4.17	3.98	3.21	2.96
Tail	.37	.39	.35	.21	.24	.29	.37	.27	.26
Total	**11.37**	**10.57**	**8.55**	**6.99**	**6.89**	**9.52**	**9.67**	**7.74**	**7.26**
Miscellaneous, per cent of carcass									
Tongue	.77	.50	.44	.34	.32	.58	.47	.45	.37
Kidneys	.63	.51	.46	.37	.35	.39	.38	.30	.31
Head remains	10.41	9.49	6.48	5.32	5.30	7.31	7.71	6.12	5.66
Back fat skin	1.41	1.35	1.16	1.56	1.82	1.53	1.54	1.51	1.73
Total	**13.22**	**11.85**	**8.54**	**7.59**	**7.79**	**9.81**	**10.10**	**8.38**	**8.07**
Average thickness of back fat	.44	.90	1.12	1.51	1.86	.67	.96	1.34	1.67
Average refractive index	**1.4626**	**1.4609**	**1.4604**	**1.4596**	**1.4590**	**1.4613**	**1.4616**	**1.4601**	**1.4594**

*From birth.

TABLE 7.—Slaughter data of pigs in experiment 1, lots 3 and 4

Lot	Medium fat rations							
	Lot 3—rapid gaining				Lot 4—slower gaining			
Approximate weight at slaughter, lb.	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	2	2	10	9	2	2	10	9
Average daily gain, lb	0.55	1.05	1.39	1.36	0.73	0.92	0.89	1.00
Average weight at Wooster, lb	100.7	150.0	207.7	255.2	104.2	149.7	205.0	257.5
Average weight at Canton, lb	98.8	147.7	203.6	251.1	102.9	146.8	201.6	253.7
Shrink in transit, per cent	1.9	1.5	2.0	1.6	1.2	1.9	1.7	1.5
Average weight of cuts, lb	70.0	107.8	157.8	198.7	154.1	116.7	154.5	201.2
Cutting yield, per cent of Canton weight	70.8	73.2	77.5	79.1	74.9	79.5	76.6	79.3
Lean cuts, per cent of carcass								
Hams, skinned	18.79	16.66	16.05	14.81	19.13	17.61	16.34	15.95
Loins	13.75	13.27	13.09	12.03	14.95	13.69	13.13	12.02
Shoulders	15.98	14.90	14.07	13.10	15.45	14.86	14.23	13.83
Lean trimmings	6.78	7.33	6.29	5.79	5.35	6.25	6.25	6.65
Total	**55.30**	**52.16**	**49.50**	**45.73**	**54.88**	**52.41**	**49.95**	**48.45**
Fat cuts, per cent of carcass								
Sides	10.40	10.74	11.42	11.28	9.57	14.93	10.57	10.52
Cheeks	2.63	1.55	1.99	2.55	2.11	1.85	2.58	2.30
Skinned back fat	3.22	6.20	7.11	9.38	4.18	4.07	7.35	7.81
Fat trimmings	8.39	11.13	12.09	13.76	8.80	8.14	11.26	13.39
Leaf fat	1.27	1.62	2.44	2.97	1.24	1.69	2.52	3.04
Total	**25.91**	**31.24**	**35.05**	**39.94**	**25.90**	**30.68**	**34.28**	**37.06**
Bony cuts, per cent of carcass								
Spare ribs	2.61	2.29	2.87	2.29	3.39	3.05	2.63	2.48
Neck bones	1.96	1.71	1.62	1.41	1.89	1.90	1.67	1.68
Feet	4.24	3.48	3.05	2.79	4.05	3.37	3.16	2.72
Tail	.36	.17	.27	.23	.40	.32	.27	.20
Total	**9.17**	**7.65**	**7.81**	**6.72**	**9.73**	**8.64**	**7.73**	**7.08**
Miscellaneous, per cent of carcass								
Tongue	.49	.43	.38	.34	.49	.48	.43	.35
Kidneys	.45	.35	.39	.34	.45	.38	.33	.27
Head remains	7.54	6.55	5.44	5.25	6.85	6.18	5.97	5.34
Back fat skin	1.14	1.62	1.43	1.68	1.70	1.23	1.31	1.45
Total	**9.62**	**8.95**	**7.64**	**7.61**	**9.49**	**8.27**	**8.04**	**7.41**
Average thickness of back fat	.62	1.46	1.48	1.96	.74	.96	1.46	1.73
Average refractive index	**1.4624**	**1.4621**	**1.4617**	**1.4611**	**1.4626**	**1.4620**	**1.4623**	**1.4616**

TABLE 8.—Slaughter data of pigs in experiment 1, lots 5 and 6

Lot	High-fat rations							
	Lot 5—rapid gaining				Lot 6—slower gaining			
Approximate weight at slaughter, lb.	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	2	2	11	7	2	2	10	9
Average daily gain, lb.	0.92	1.30	1.35	1.34	0.78	0.99	1.00	1.08
Average weight at Wooster, lb.	107.5	153.0	202.2	252.2	108.0	155.2	206.0	253.3
Average weight at Canton, lb.	107.0	151.3	197.5	246.6	106.5	151.5	201.9	249.6
Shrink in transit, per cent.	.5	1.1	2.3	2.2	1.4	2.4	2.0	1.5
Average weight of cuts, lb	79.7	113.3	155.9	197.4	80.2	111.8	155.2	197.0
Cutting yield, per cent of Canton weight	74.5	74.9	77.4	80.0	75.3	73.8	76.9	78.9
Lean cuts, per cent of carcass								
Ham, skinned	18.30	17.11	15.89	15.65	18.85	17.47	16.57	16.62
Loins	13.56	13.35	12.42	12.26	15.29	14.65	13.14	12.40
Shoulders	15.03	14.15	13.69	13.59	15.11	15.56	14.09	14.21
Lean trimmings	5.92	6.85	6.22	6.74	6.50	7.46	6.34	6.84
Total	**52.81**	**51.46**	**48.22**	**48.24**	**55.75**	**55.14**	**50.14**	**50.07**
Fat cuts, per cent of carcass								
Sides	9.68	10.13	11.32	10.18	8.86	10.23	10.27	10.27
Cheeks	2.04	1.96	2.04	2.47	2.28	2.27	2.28	2.59
Skinned back fat	5.94	6.36	7.83	8.14	4.13	4.84	7.18	7.29
Fat trimmings	9.21	11.03	12.90	13.70	8.68	7.94	11.84	12.58
Leaf fat	1.47	2.37	2.53	2.88	1.44	1.59	2.45	2.50
Total	**28.34**	**31.85**	**36.62**	**37.37**	**25.39**	**26.87**	**34.02**	**35.23**
Bony cuts, per cent of carcass								
Spare ribs	3.00	2.49	2.60	2.37	3.32	3.13	2.74	2.49
Neck bones	2.04	1.49	1.69	1.66	1.83	1.65	1.72	1.65
Feet	3.84	3.28	3.05	2.77	3.82	3.75	3.19	2.85
Tail	.35	.32	.22	.25	.35	.22	.29	.25
Total	**9.23**	**7.58**	**7.56**	**7.05**	**9.32**	**8.75**	**7.94**	**7.24**
Miscellaneous, per cent of carcass								
Tongue	.51	.44	.35	.34	.55	.39	.41	.37
Kidneys	.43	.44	.37	.35	.39	.29	.33	.30
Head remains	7.39	6.84	5.50	4.99	7.24	6.82	5.79	5.40
Back fat skin	1.29	1.39	1.38	1.66	1.36	1.74	1.37	1.39
Total	**9.62**	**9.11**	**7.60**	**7.34**	**9.54**	**9.24**	**7.90**	**7.46**
Average thickness of back fat	.99	1.26	1.51	1.88	.79	1.07	1.44	1.69
Average refractive index	**1.4632**	**1.4637**	**1.4632**	**1.4629**	**1.4644**	**1.4638**	**1.4635**	**1.4634**

TABLE 9.—Effect of weight and of full and limited feeding on the yields of pork cuts

	Representative pigs	Full-fed				Limited-fed			
		Lots 1, 3, and 5				Lots 2, 4, and 6			
Approximate weight at slaughter, lb.	**50**	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	4	6	6	30	26	6	6	30	27
Average daily gain, lb.	0.60‡	0.76	1.16	1.38	1.35§	0.75	0.86	0.89	1.00
Average weight at Wooster, lb	55.4	105.6	152.3	204.6	253.7	104.7	152.2	206.7	255.8
Average weight at Canton, lb.	56.2	103.8	150.3	200.4	248.7	103.3	149.0	203.2	252.2
Shrink in transit, per cent	+1.6	1.7	1.3	2.1	2.0	1.3	2.1	1.7	1.4
Average weight of cuts, lb	38.3	75.4	112.5	155.2	198.5	77.6	112.8	155.7	199.2
Cutting yield, per cent of Canton weight	68.2	72.6	74.8	77.4	79.8	75.2	75.7	76.7	79.0
Lean cuts, per cent of carcass									
Hams, skinned	17.81	18.05	17.63	15.85	15.13	18.84	17.98	16.70	16.31
Loins	13.80	13.75	13.49	12.51	12.12	15.28	14.65	13.24	12.34
Shoulders	16.32	15.29	14.71	13.73	13.26	15.23	15.76	14.31	14.03
Lean trimmings	2.41	5.64	7.15	6.50	6.42	6.39	6.23	6.57	6.52
Total	**50.34**	**52.73**	**52.98**	**48.59**	**46.93**	**55.74**	**54.62**	**50.82**	**49.20**
Fat cuts, per cent of carcass									
Sides	12.68	9.88	10.25	11.34	10.73	9.16	11.79	10.25	10.56
Cheeks	3.00	2.33	2.06	2.10	2.41	2.17	2.11	2.42	2.52
Skinned back fat	3.42	4.90	5.93	7.61	8.83	3.96	4.16	6.90	7.42
Fat trimmings	5.05	8.81	10.24	12.74	13.74	8.55	7.59	11.31	12.75
Leaf fat	.92	1.33	1.74	2.54	2.88	1.29	1.53	2.39	2.71
Total	**25.07**	**27.25**	**30.22**	**36.33**	**38.59**	**25.13**	**27.18**	**33.27**	**35.96**
Bony cuts, per cent of carcass									
Spare ribs	3.58	3.16	2.56	2.65	2.27	3.30	3.14	2.65	2.48
Neck bones	2.59	2.05	1.60	1.58	1.57	1.86	1.88	1.69	1.63
Feet	4.83	4.09	3.49	3.01	2.79	4.01	3.69	3.19	2.85
Tail	.37	.36	.29	.23	.24	.35	.30	.27	.23
Total	**11.37**	**9.66**	**7.94**	**7.47**	**6.87**	**9.52**	**9.01**	**7.80**	**7.19**
Miscellaneous, per cent of carcass									
Tongue	.77	.50	.44	.36	.33	.53	.45	.43	.36
Kidneys	.63	.46	.42	.38	.35	.41	.35	.32	.30
Head remains	10.41	8.15	6.62	5.42	5.20	7.14	6.89	5.96	5.47
Back fat skin	1.41	1.26	1.38	1.45	1.73	1.53	1.50	1.40	1.52
Total	**13.22**	**10.37**	**8.86**	**7.61**	**7.61**	**9.61**	**9.19**	**8.11**	**7.65**
Average thickness of back fat	.44	.84	1.28	1.50	1.90	.74	1.00	1.41	1.70
Average refractive index	**1.4626**	**1.4622**	**1.4621**	***1.4616**	**1.4608**	**1.4628**	**1.4625**	**†1.4619**	**1.4615**

*Average for 56 head, 1.4614. †Average for 57 head, 1.4619. ‡From birth. §The rapidity of the gains of these was retarded somewhat by the operations for the removal of fat samples. Normally full-fed pigs carried to 250 lb. would make faster average gains than pigs carried to 200 lb.

Influence of Weight and Rate of Fattening on Fatness and Firmness

Data for the various groupings, showing initial and final weights, daily gains, cutting yields, thickness of the back fat, condition or fatness at slaughter, rate of fat deposition, and firmness of fat as measured by the refractive indexes are presented in table 10.

Possibly, rapidity of gains is not as accurate a measure of the rate of fat deposition as some other index. However, it is believed that pigs of similar breeding and type, on adequate and reasonably liberal rations, tend to grow at about the same rate. If they do, and these conditions have existed, probably differences in rapidity of gains which occur are due chiefly to differences in the rate of fattening. Both the daily gains from the beginning of the test and for the 50-pound period immediately preceding slaughter are shown. The average daily gain given for the four representative pigs slaughtered at the beginning of the test is from birth to the time of slaughter.

The fatness index used differs from that employed by Warner, Ellis, and Howe (16) in that they used the combined weight of the side, leaf and skinned back fat, and fat trimmings expressed as a percentage of the cooled carcass weight, whereas the index used here includes in addition to the above items the weight of the cheeks or jowls and the fat trimmings from the head. This resulted in higher values in this test than were obtained by them.

Except for slight differences caused by such factors as conversion into cuts, variations in weight readings, or moisture changes, the cooled dressing per cent and the cutting per cent are the same. The thickness of the back fat and the cooled dressing per cent, which is expressed in the table as cutting per cent, are other indexes of fatness. As hogs become fatter their dressing percentage increases. Conversely, a higher dressing percentage in hogs of similar type and weight is indicative of fatter animals.

Hankins and Ellis (10) found that the average thickness of the back fat was a hog-carcass characteristic of very definite value for estimating fatness of the edible portion of the carcass. It would be less reliable for hogs of variable than for hogs of similar type.

The rate of fat deposition was obtained by dividing the fatness index by the number of days required to make a gain of 150 pounds. It is intended to take into account both the fatness of the carcass and the length of time required by the animal to reach that degree of fatness. The degree of fatness of the limited-fed pigs at 250 pounds was not greatly different from that of the full-fed pigs at 200 pounds but the length of time required by them to reach the similar degree of fatness was greater. Pigs which have made the same average daily gains can differ in fatness at a given weight. One may have gained more largely as the result of muscular and skeletal development and another more largely as the result of fattening. At a given weight, however, the former would be thinner than the latter and would then show a lower fatness index and rate of fat deposition than would one which had grown less and fattened more.

The refractive index was taken as a measure of the relative firmness of the back fat. In Bulletin 1492 of the U. S. Department of Agriculture, Hankins, Ellis, and Zeller (9) state that "back fat has been found to be representative of the entire body fat. The difference between leaf fat and back fat varies somewhat with the ration used. Leaf fat is occasionally as soft as back fat." As the amount of low melting fat in the sample decreases the

TABLE 10.—Influence of rate of fat deposition on the firmness of fat of hogs, experiment 1

	Representative pigs	Low fat ration, 2.6 per cent							
		Lot 1—rapid gains				Lot 2—slower gains			
Approximate weight at slaughter, lb.	**50**	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	4	2	2	19	10	2	2	19	9
Initial weight per pig, lb		47	59	53	49	53	45	52	53
Final weight per pig, lb	55	108	153	203	253	104	152	203	256
Average daily gain, lb.									
Entire time	.60	.90	1.15	1.36	1.36	.73	.73	.81	.94
Preceding 50 lb. period	.60	.90	1.55	1.72	1.52	.73	.95	1.23	1.59
Average cutting yield, per cent	69.2	70.5	75.4	76.0	78.6	74.3	72.5	75.4	77.7
Average fatness index	25.1	27.3	27.7	37.4	38.2	24.1	23.8	31.5	35.6
Average rate of fat deposition		.16	.21	.35	.27	.12	.12	.17	.17
Average thickness of back fat, inches	.44	.90	1.12	1.51	1.86	.67	.96	1.34	1.67
Average refractive index	**1.4626**	**1.4609**	**1.4604**	**1.4596**	**1.4590**	**1.4613**	**1.4616**	**1.4601**	**1.4594**
		Medium fat ration, 5.6 per cent							
		Lot 3—rapid gains				Lot 4—slower gains			
Approximate weight at slaughter, lb.		**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs		2	2	19	9	2	2	19	9
Initial weight per pig, lb		49	54	54	45	54	54	52	48
Final weight per pig, lb		99	150	206	254	106	147	202	256
Average daily gain, lb.									
Entire time		.55	1.05	1.31	1.36	.73	.92	.90	1.00
Preceding 50 lb. period		.55	1.46	1.68	2.02	.73	1.08	1.27	1.44
Average cutting yield, per cent		69.5	71.9	75.9	77.9	73.9	78.0	75.4	78.1
Average fatness index		25.9	31.2	35.0	40.0	25.8	30.6	34.3	37.0
Average rate of fat deposition		.09	.22	.32	.27	.13	.19	.20	.18
Average thickness of back fat, inches		.62	1.14	1.48	1.96	.74	.96	1.46	1.73
Average refractive index		**1.4624**	**1.4621**	**1.4616**	**1.4611**	**1.4626**	**1.4620**	**1.4622**	**1.4616**

TABLE 10.—Influence of rate of fat deposition on the firmness of fat of hogs, experiment 1—Continued

		High fat ration, 8.7 per cent							
		Lot 5—rapid gains				Lot 6—slower gains			
Approximate weight at slaughter, lb.		**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs		2	2	19	7	2	2	19	9
Initial weight per pig, lb.		45	58	53	53	54	57	51	52
Final weight per pig, lb.		106	154	204	254	108	157	205	252
Average daily gain, lb.									
Entire time		.92	1.30	1.30	1.34	.78	.99	.99	1.08
Preceding 50 lb. period		.92	1.64	1.67	1.84	.78	1.19	1.58	1.61
Average cutting yield, per cent		74.2	74.1	75.6	78.3	74.3	72.0	75.3	77.7
Average fatness index		28.2	31.9	36.6	37.4	25.4	27.1	34.0	35.2
Average rate of fat deposition		.17	.27	.33	.25	.13	.19	.23	.19
Average thickness of back fat, inches		.99	1.26	1.51	1.88	.79	1.02	1.44	1.69
Average refractive index		**1.4632**	**1.4637**	**1.4632**	**1.4629**	**1.4644**	**1.4638**	**1.4635**	**1.4634**

melting point rises and the refractive index reading decreases. A high refractive index indicates an oily fat and a low refractive index a firm or hard fat.

Although in the present study the relative softness or firmness of the fat is of chief concern, the carcass grade may be of some interest. Based on the refractive index of the back fat given by Hankins, Ellis, and Zeller (9) the carcass gradings for hogs fed corn and supplement were as follows:

REFRACTIVE INDEX	GRADE
1.4597 and below	Hard
1.4598—1.4601	Medium hard
1.4602—1.4605	Medium soft
1.4606—1.4618	Soft
1.4619 and above	Oily

Classified on this basis, according to the average refractive indexes, the pigs that were butchered at weights of 200 and 250 pounds and that were fed rations containing low, medium, and high amounts of fat killed out firm, soft, and oily, respectively.

At the 200-pound weight, the spread in the average refractive index from the low to the high fat ration for the full-fed pigs was 0.0036 and for the limited-fed pigs was 0.0034. At the 250-pound weight it was 0.0039 for the full- and 0.0040 for the limited-fed pigs.

Table 11 shows the average refractive indexes of the fat samples taken from the same pigs when they weighed approximately 100, 150, 200, and 250 pounds, that is at progressive stages of the development of the same individuals. On the whole, they correspond very closely to the average refractive indexes of the pigs that were slaughtered at corresponding weights.

In table 12, the data for the three full- and for the three limited-fed groups of pigs are combined. If the methods of making the determinations were reliable, the pigs slaughtered at the 250-pound weights deposited fat at a slower rate than those slaughtered at the 200-pound weights. The difference between the two groups was greater in the case of the full- than in the case of the limited-fed pigs. The removal of from one to three fat samples from them tended to slow down their rate of fat deposition.

When they were slaughtered at approximately the same weights, the fat of rapid gaining pigs was slightly firmer or less soft than was the fat of pigs which gained more slowly. As both the full-fed and the limited-fed pigs became heavier, there was an increase in the firmness of the fat. These differences were not as pronounced as were those caused by varying the percentage of oily fat in the ration.

The rapid gaining pigs were as fat at a weight of 200 pounds as were the slower gaining pigs at a weight of 250 pounds. When they were slaughtered at approximately the same degree of fatness, regardless of weight or of the length of the feeding period, there was little or no difference in the firmness of the fat of the slow and of the faster gaining pigs.

Yields of Lard

According to the "Packers Encyclopedia" the yield of lard from leaf fat is 92 per cent and that from back fat and pork trimmings varies from 80 to 85 per cent. Based on yields of 92 per cent from the leaf fat, 84 per cent from the skinned back fat, and 82 per cent from the fat trimmings, the estimated

TABLE 11.—The firmness of fat from the same hogs at different stages of their development

	Low fat ration, 2.6 per cent							
	Lot 1 B—rapid gains				Lot 2 B—slower gains			
Approximate weight when sample was taken, lb.	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	5	5	5	5	5	4	4	4
Initial weight per pig, lb.	49	103	143	201	56	105	154	205
Final weight per pig, lb.	103	143	201	255	104	154	205	262
Average daily gain, lb.								
Entire time	0.93	1.07	1.26	1.30	0.63	0.81	0.89	1.02
Preceding 50 lb. period	0.93	1.33	1.78	1.43	0.63	1.07	1.10	1.64
Average thickness of back fat, inches	.....	.....	.....	1.66	.....	.....	.....	1.69
Average refractive index	**1.4606**	**1.4600**	**1.4597**	**1.4590**	**1.4613**	**1.4607**	**1.4602**	**1.4594**

	Medium fat ration, 5.6 per cent							
	Lot 3 B—rapid gains				Lot 4 B—slower gains			
Approximate weight when sample was taken, lb.	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	5	5	5	5	5	5	5	5
Initial weight per pig, lb.	46	99	160	200	51	99	155	202
Final weight per pig, lb.	99	160	200	252	99	155	202	259
Average daily gain, lb.								
Entire time	.96	1.22	1.28	1.40	.61	.78	.87	.98
Preceding 50 lb. period	.96	1.73	1.48	1.97	.61	1.02	1.20	1.45
Average thickness of back fat, inches	.....	.....	.....	1.91	.....	.....	.....	1.71
Average refractive index	**1.4621**	**1.4617**	**1.4612**	**1.4610**	**1.4630**	**1.4625**	**1.4623**	**1.4618**

	High fat ration, 8.7 per cent							
	Lot 5 B—rapid gains				Lot 6 B—slower gains			
Approximate weight when sample was taken, lb.	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	3	3	3	3	5	5	5	5
Initial weight per pig, lb.	56	106	158	207	51	105	153	207
Final weight per pig, lb.	106	158	207	250	105	153	207	252
Average daily gain, lb.								
Entire time	.91	1.05	1.16	1.27	.68	.83	.97	1.06
Preceding 50 lb. period	.91	1.23	1.49	1.86	.68	1.10	1.45	1.53
Average thickness of back fat, inches	.....	.....	.....	1.92	.....	.....	.....	1.71
Average refractive index	**1.4637**	**1.4631**	**1.4631**	**1.4629**	**1.4651**	**1.4638**	**1.4634**	**1.4635**

TABLE 12.—Influence of rate of fat deposition on the firmness of fat of hogs

(Data for the three full- and for the three limited-fed lots combined)

		Rapid gains Lots 1, 3, and 5				Slower gains Lots 2, 4, and 6			
Approximate weight at slaughter, lb.	**50**	**100**	**150**	**200**	**250**	**100**	**150**	**200**	**250**
Number of pigs	4	6	6	30	26	6	6	30	27
Initial weight per pig, lb	4†	48.9	57.0	57.3	48.7	53.9	53.2	52.0	51.1
Final weight per pig, lb.	55	106	152	205	254	105	152	207	256
Average daily gain, lb.									
Entire time	.60	0.76	1.16	1.38	1.35	0.75	0.86	0.89	1.00
Prededing 50 lb. period	.60	0.76	1.55	1.79	1.75	0.75	1.06	1.37	1.54
Average cutting per cent.	68.2	72.6	74.8	77.4	79.8	75.2	75.7	76.7	79.0
Average fatness index	25.1	27.2	30.2	36.3	38.6	25.1	27.2	33.3	36.0
Average rate of fat deposition	.....	**0.13**	**0.23**	**0.33**	**0.26***	**0.12**	**0.16**	**0.20**	**0.18**
Average thickness of back fat, inches	0.44	0.84	1.28	1.50	1.90	0.74	1.00	1.41	1.70
Average refractive index	**1.4626**	**1.4622**	**1.4621**	**1.4616**	**1.4608**	**1.4623**	**1.4625**	**1.4619**	**1.4615**

*One or three samples of fat were removed from the pigs carried to the 250-pound weight. This tended to slow down the rate of gain or rate of fat deposition of the full-fed pigs.

†At 4 days of age; other groups at beginning of experiment.

yields of lard from the full- and from the limited-fed pigs which were slaughtered at the various weights are given in table 13. The percentage yields in relation to the live weights at slaughter and to the weights of the total cuts, which correspond closely to the cooled carcass weights, are also shown.

As previously mentioned, the removal of from one to three fat samples slowed down the rate of fat deposition of the hogs that were slaughtered at the 250 pound weights, particularly those that were full-fed. Doubtless this resulted in a lower yield of lard than is typical of full-fed pigs of similar type and weight.

TABLE 13.—Influence of weight and of full and limited feeding on the yield of lard

No. of pigs	Initial weight per pig Lb.	Average days of age at slaughter	Average live weight at slaughter Lb.	Average daily gain Lb.	Estimated yield of lard Lb.	Relation of lard yield to live weight* Pct.	Relation of lard yield to total cuts † Pct.
Full feed							
4.....	4.0‡	88	56.2	.60	3.01	5.4	**7.9**
6.....	48.9	149	103.8	.76	9.47	9.1	**12.6**
6.....	57.0	170	150.3	1.16	16.84	11.2	**15.0**
30.....	57.3	191	200.4	1.38	29.76	14.9	**19.2**
26.....	48.7	229	248.7	1.35	42.36	17.0	**21.3**
Limited feed							
6.....	53.9	149	103.3	.75	8.95	8.7	**11.5**
6.....	52.2	199	149,0	.86	12.55	8.4	**11.1**
29.....	52.0	251	203.2	.89	26.89	13.2	**17.3**
27.....	51.1	282	252.2	1.00	38.21	15.2	**19.2**

*Live weight at slaughter, that is shrunk or after trucking, as given in table 9.
†Includes head, ham facings, leaf fat and kidneys but not liver, heart, and spleen.
‡At 4 days of age.

EXPERIMENT 2

Plan of Experiment

In the second experiment, rations containing approximately 4.2 and 5.6 per cent of fat were each fed to two groups of 10 pigs each. The ration containing approximately 5.6 per cent of fat was the same as the medium-fat ration in the first experiment. The other contained the same feeds but less corn oil. Its fat content was approximately the same as that of a corn ration, and was about midway between that of the low- and medium-fat rations in the first trial.

One group of pigs on each ration was self-fed for rapid gains. The feed for the other was limited in order to force them to gain more slowly. Before and after they reached a weight of about 150 pounds their daily feed approximated 2.75 and 2.5 per cent of their live weight, respectively. The amounts of feed taken daily by the self-fed pigs of lots 1 and 3 averaged approximately 3.8 and 3.6 per cent of their weight, respectively.

All of the full-fed pigs were butchered at a weight of approximately 200 pounds. Five pigs in each of the limited-fed lots were slaughtered at the 200-pound weight. Five were carried to a weight of 250 pounds. However, fat samples were taken from these at the 200-pound weight.

Feed Lot Performance

Table 14 gives the feed lot performance of the four groups to the 200 pound weight.

TABLE 14.—Feed lot performance of pigs in experiment 2

	Lot 1	Lot 2	Lot 3	Lot 4
Per cent of fat	4.2		5.6	
Amount of feed	**Full**	**Limited**	**Full**	**Limited**
Number of pigs	10	10	10	10
Initial weight per pig, lb	51.8	51.3	52.1	50.2
Final weight per pig, lb	205.6	203.3	207.4	208.2
Average daily gain, lb	**1.29**	**.88**	**1.38**	**.92**
Daily feed per pig, lb.				
Grain	3.87	2.45	3.60	2.33
Protein concentrate	.72	.46	.68	.44
Ground alfalfa	.20	.12	.19	.12
Minerals	.04	.02	.04	.03
Corn oil	.08	.05	.14	.09
Total	4.91	3.11	4.65	3.01
Feed per 100 lb. gain, lb.				
Grain	299.48	279.21	261.25	253.37
Protein concentrate	55.80	52.02	49.62	48.12
Ground alfalfa	15.18	14.16	13.50	13.09
Minerals	3.04	2.83	2.70	2.62
Corn oil	6.07	5.66	10.46	10.15
Total	**379.57**	**353.89**	**337.53**	**327.35**
Feed per 100 lb. gain with fat × 2.25	399.50	361.58	372.47	350.67

As in the first trial, the full-fed pigs on the higher fat ration took slightly less feed daily a head but gained more rapidly and required less feed per unit of gain than those on the low fat ration. The limited-fed pigs on the high fat ration likewise required less feed per unit of gain than the limited-fed pigs on the low fat ration. The difference in energy value was sufficient to account for only a part of the difference in the feed required per unit of gain. On both rations, the limited-fed pigs made greater gains per unit of feed consumed than the self-fed pigs.

TABLE 15.—Shrinkage from transporting, killing, cooling, and cutting, experiment 2

	Lot 1	Lot 2		Lot 3	Lot 4	
	Full-fed	**Limited-fed**		**Full-fed**	**Limited-fed**	
Approximate weight at slaughter, lb	**200**	**200**	**250**	**200**	**200**	**250**
Number of pigs	10	5	5	10	5	5
Average weight at Wooster a. m. lb.	205.8	204.8	255.8	206.4	203.7	258.1
Average weight at Canton, a. m. lb.	201.1	201.5	252.5	201.9	200.3	253.7
Shrink in transit, per cent	2.3	1.6	1.3	2.2	1.7	1.7
Average warm, dressed weight, lb.	156.9	155·4	207.0	158.6	159.2	207.8
Warm dressed yield, per cent						
Basis Wooster weight	76.1	75.9	80.9	76.8	78.2	80.5
Basis Canton weight	78.0	77.1	82.0	78.6	79.5	81.9
Average cooled, dressed weight, lb.	152.8	152.4	202.2	155.4	155.8	204.0
Shrink in cooling, per cent	2.6	1.9	2.3	2.0	2.1	1.8
Cooled, dressed yield, per cent						
Basis Wooster weight	74.1	74.4	79.0	75.0	76.7	79.0
Basis Canton weight	76.0	75.6	80.2	76.6	78.0	80.4
Average weight of cuts and trimmings, lb.	152.3	152.2	202.2	154.7	156.3	205.5
Yield of cuts and timmings, per cent						
Basis Wooster weight	**73.9**	**74.3**	**79.1**	**75.2**	**76.7**	**79.6**
Basis Canton weight	75.7	75.5	81.4	76.6	78.0	81.0
Liver, per cent of Wooster weight	2.2	1.9	1.6	2.3	1.6	1.5
Heart, per cent of Wooster weight	.3	.3	.3	.3	.3	.3

Yields of Pork and Pork Cuts

Table 15 shows the average weights of the pigs in the different groups before and after trucking to the packing plant, the warm and the cooled dressed weights, the weights of the livers and hearts, and the total weights of the cuts from the cooled carcasses.

TABLE 16.—Cutting data of pigs in experiment 2

	Lot 1	Lot 2		Lot 3	Lot 4	
	Full-fed	**Limited-fed**		**Full-fed**	**Limited-fed**	
Fat in ration, per cent	**4.2**	**4.2**		**5.6**	**5.6**	
Approximate weight at slaughter, lb	200	200	250	200	200	250
Number of pigs	10	5	5	10	5	5
Average daily gain, lb	1.29	.88*	.97	1.38	.92*	1.00
Average weight at Wooster, a.m., lb	205.8	204.8	255.8	206.4	203.7	258.1
Average weight at Canton, a.m., lb	201.1	201.5	252.5	201.9	200.3	253.7
Shrink in transit, per cent	2.3	1.6	1.3	2.2	1.7	1.7
Average weight of cuts, lb	152.3	152.2	202.2	154.7	156.3	205.5
Cutting yield, per cent of carcass	73.9	74.3	79.1	75.2	76.7	81.0
Lean cuts, per cent of carcass						
Hams, skinned	15.78	17.28	15.39	15.82	17.04	15.92
Loins	12.27	12.76	12.46	12.65	13.25	12.07
Shoulders	14.11	15.11	14.25	13.98	14.57	13.91
Lean trimmings	7.04	8.03	6.76	6.92	6.97	7.07
Total	**49.20**	**53.18**	**48.86**	**49.37**	**51.83**	**48.97**
Fat cuts, per cent of carcass						
Sides	10.51	9.75	10.42	11.03	9.70	10.16
Cheeks	2.61	1.96	2.31	2.51	2.23	1.87
Skinned back fat	8.24	5.93	8.04	7.75	6.70	7.93
Fat trimmings	11.67	10.31	12.30	11.54	11.28	13.35
Leaf fat	2.06	2.39	3.05	2.55	2.27	2.90
Total	**35.09**	**30.34**	**36.12**	**35.38**	**32.18**	**36.21**
Bony cuts, per cent of carcass						
Spare ribs	2.59	2.87	2.46	2.59	2.71	2.32
Neck bones	1.72	1.74	1.66	1.65	1.63	1.73
Feet	3.21	3.25	2.85	2.98	3.15	2.67
Tail	.21	.23	.28	.21	.22	.22
Total	7.73	**8.09**	**7.25**	**7.43**	**7.71**	**6.94**
Miscellaneous, per cent of carcass						
Tongue	.32	.41	.34	.35	.35	.36
Kidneys	.41	.26	.31	.38	.26	.30
Head remains	5.83	6.44	5.69	5.58	6.28	5.81
Back fat skin	1.42	1.28	1.43	1.51	1.39	1.41
Total	**7.98**	**8.39**	**7.77**	**7.82**	**8.28**	**7.88**
Average thickness of back fat, inches	1.51	1.25	1.67	1.52	1.32	1.74
Average refractive index	**1.4600**	***1.4610**	**1.4601**	**1.4613**	***1.4618**	1.4606

*Average of 10 head.

Table 16 summarizes the cutting data of the carcasses of the pigs in experiment 2. As in the first trial, the carcasses of the limited-fed pigs yielded a larger percentage of ham, loin, and total lean cuts and a smaller percentage of bacon and fat than the carcasses of the full-fed pigs of similar weight.

Influence of Weight and Rate of Fattening on Fatness and Firmness

The fatness of the carcasses and the rate of fat deposition are shown in table 17. When the slower gaining pigs weighed 200 pounds their fat was softer than was that of the full-fed or faster gaining pigs at the same weight. When they weighed 250 pounds, however, both their condition or degree of fatness and the firmness of their fat corresponded closely to the condition and to the firmness of the fat of the full-fed pigs at the 200 pound weight. Whether it was due to the rate of fattening or to the degree of fatness, the pigs which fattened slowly had a less firm fat than similar pigs of similar weight which had received the same ration but which had fattened more rapidly.

TABLE 17.—Influence of the rate of fat deposition on the firmness of fat of hogs, experiment 2

	Lot 1	Lot 2		Lot 3	Lot 4	
	Full-fed	Limited-fed		Full-fed	Limited-fed	
Fat in ration, per cent	4.2	4.2		5.6	5.6	
Weight at slaughter, lb	200	200	250	200	200	250
Number of pigs	10	5	5	10	5	5
Initial weight per pig, lb.	51.8	49.0	50.8	52.1	51.8	50.7
Final weight per pig, lb.	205.6	204.9	257.0	207.4	204.5	260.4
Average daily gain, lb.	1.29	0.91	0.97	1.38	.93	1.00
Average cutting per cent.	73.9	74.3	79.1	75.2	76.7	79.6
Fatness index	35.1	30.3	36.1	35.4	32.2	36.2
Rate of fat deposition	0.30	0.18	.....	0.32	0.21	.....
Average thickness of back fat, inches	1.51	1.25	1.67	1.52	1.32	1.74
Average refractive index	1.4600	1.4610*	1.4601	1.4613	1.4618*	1.4606

*Average of 10 head; fat samples of five were taken from the live animals which were slaughtered later at the 250-pound weight.

SUMMARY

In a dry lot trial, low, medium, and high fat rations were each fed to two groups of pigs. One group on each ration was self-fed for rapid gains, whereas the other was limited-fed for slower gains.

Four 50-pound pigs, representative of those used in the test, were slaughtered at the time the test was started. Then 2 pigs from each group were slaughtered at 100-, 2 at 150-, 9 to 11 at 200-, and 7 to 10 pigs at 250-pound weights. At weights of approximately 100 and 150 pounds, back fat samples were taken from five live pigs in each group. At a weight of approximately 200 pounds, back fat samples were taken from all of the pigs in each group that were continued to a weight of 250 pounds, including the five from which two samples had previously been removed. Refractive index readings for the determination of the firmness of rendered back fat samples, measurements of the thickness of the back fat, and individual yields of the cuts were obtained on all of the pigs slaughtered.

As a rule, although they gained more slowly, the pigs whose daily feed was limited to approximately 2.75 per cent of their weight made greater gains per unit of feed consumed than did the self-fed pigs.

The self-fed pigs receiving rations higher in fat took less feed daily a head but gained as fast or faster and made greater gains per unit of feed consumed than the self-fed pigs receiving rations lower in fat. The higher energy

values of the higher fat rations were sufficient to account for only a portion of the saving in feed per unit of gain. Since limiting the feed somewhat increased the effectiveness of the rations, the lower feed intake of the self-fed pigs on the higher fat rations probably was a factor contributing to the greater gains made by them per unit of feed consumed.

As the weight at slaughter became heavier, the dressed and cutting yields increased. As a rule, the fatter the hogs were at a given weight, the greater was their dressing percentage or their yield of total cuts.

The carcasses of limited-fed hogs contained a higher percentage of loin and of trimmed ham and a lower percentage of fat cuts than the carcasses of full-fed hogs of similar weight. Among those that were similarly fed, the carcasses of the heavier hogs contained a higher percentage of fat and yielded a higher percentage of lard than the carcasses of lighter hogs.

Increasing the percentage of oily fat in the feed increased the softness of the pork.

Refractive indexes of rendered samples of back fat, both when the samples were taken from the same hogs at weights of 100, 150, 200, and 250 pounds and when they were taken from hogs slaughtered at the different weights, showed that as hogs became heavier their fat became less soft or more firm.

When they were fed the same ration and slaughtered at the same weight, the fat of rapid gaining hogs was slightly firmer or less soft than was the fat of hogs which had gained more slowly. The rations contained from 2.6 to 8.7 per cent of fat.

Usually the full-fed, or rapid gaining hogs, were as fat at 200 pounds as were the limited-fed or slower gaining hogs at 250 pounds. When they were of equal fatness at slaughter, regardless of weight or length of time fed, there was little difference in the firmness of fat of the slow and of the faster gaining hogs.

Both the rate of fat deposition and the weight or degree of fatness at slaughter influenced the firmness of the pork but not to as great an extent as did the fat content of the feed.

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